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An Address
ON THE
POSITION OF SIR CHARLES BELL
AMONGST ANATOMISTS

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THE POSITION OF SIR CHARLES BELL AMONGST ANATOMISTS.

GENTLEMEN,—In the autumn of 1811, almost one hundred years ago, Mr. Charles Bell, aged 37, issued a little booklet for private circulation in which he expounded an "Idea of a New Anatomy of the Brain." This first account of the theory which revolutionised our conception of the master organ of the body appeared when its author was worried with the minor affairs of life. He was newly married; a few months before he had been at death's door from diphtheria; he had just moved into a house (No. 34) in Soho-square. He was having trouble with his late landlord. His last home (Speaker Onslow's old house) in Leicester-street (square) he had the misfortune to hold on a repairing lease at a rental of £96 per annum. It was this ramshackle old house which Bell selected as a basis for carrying out a frontal attack on surgical London. The surveyor he had consulted assured him it would prove a heavier burden than nine bastard children. Nevertheless, with only £12 in his pocket, he took the house, painted the door oak-colour, fixed on it a green-bronzed knocker, and "engaged a boy for £6 6s. a year, giving him a coat and hat," doubtful if he should add a silver band to the latter.¹ When the New Anatomy appeared

¹ The chief authorities I have relied on for the facts mentioned in this lecture are the following: "Letters of Sir Charles Bell, K.H.," selected from his correspondence with his brother, George Joseph Bell; London, 1870. "Historical Sketch of the Edinburgh Anatomical School," by Sir John Struthers; Edinburgh, 1867. "Dictionary of National Biography," "Dr. James Douglas and other Medical Biographies," by Dr. Norman Moore. "A History of the Medical Institutions of London," by the same writer, *Brit. Med. Jour.*, 1895, June and July. "Two Great Scotsmen: the Brothers William and John Hunter," by George R. Mather, M.D.; Glasgow, 1893. "The Story of Our Museum and Some of Its Contents," by Dr. C. E. Lakin of Middlesex Hospital, *Middlesex Hospital Journal*, June—July, 1908.

Bell's late landlord was shouting dilapidations. His museum, his lecture-room, and his two or three house pupils were also moved to Soho-square. There was trouble about the house pupils. Mrs. Bell, as newly married ladies can well understand, wished to share the privacy of her new home with her husband. "You must consider," he wrote to his brother, who acted as Mrs. Bell's ambassador, "that these young men are *house pupils* not *boarders*. Dr. Denman, Dr. Baillie, Mr. Hunter, Abernethy, Cooper, Wilson have had them or have them. Their necessity is understood, they are admitted as being essential to a lecturer." To add to his troubles, when the "Idea of a New Anatomy of the Brain" first saw light there "was an awful pause in regard to patients." He found it necessary to "give up the character of anatomist." Think of being penalised for a priceless discovery. Bell knew Harvey's life and work well; he probably consoled himself by remembering that the discovery of the circulation led to a rapid decline in Harvey's practice.

WHAT BELL ACHIEVED.

To most medical students Charles Bell is simply known as the man who found out that the anterior root of a spinal nerve is motor in function, the posterior root, sensory. His discovery was much greater than that: he formulated a new theory of the whole central nervous system—a theory which became the basis of our present knowledge. He was the last, and with the exception of John Hunter the greatest, of that remarkable London Scottish or Hunterian school of anatomists which flourished in London from the beginning of the eighteenth until well into the nineteenth century. As an artist-anatomist this country has not produced his superior. The text-book written by John and Charles Bell was not only the best text-book of anatomy of its time, but in the opinion of many is still the most practical treatise on human anatomy yet produced in the English language. He discovered the art of making the structure of man popular with the educated public. He played a prominent part when medical education was passing through a critical phase in London. During the thirty-two years there, from 1804 to 1836, the hospital schools grew in importance, while the unattached schools sank gradually out of sight. He was one of those who wished to see London supplied with a teaching university, and his name is thus connected with the foundation of University College in 1827. Eight years later (1835) he took an active part in founding the medical school of Middlesex Hospital. The establishment of this school marks the end of the London Scottish school of anatomists.

BELL'S CHARACTER.

The attitudes of men to their discoveries are as variable as parents to their children. The weak bantling needs a deal of pushing and praise to commend it to the public eye. Harvey and Darwin were ideal parents; having done their best for their discoveries they set them out in the world to rise or fall by their merits, quietly glad when they met with success, and gladly quiet when treated with injustice. That was not altogether Bell's attitude to his discoveries; he knew their merits; his children were as good as Harvey's; the weaker of them he liked best and commended most. One can see from their portraits in our National Gallery that Harvey and Bell differed as widely in features and bearing as in their attitude to their discoveries. The portrait of Bell is by J. Stevens, a Scottish Academician. The picture was probably painted soon after the battle of Waterloo, when Bell was still living in Soho-square and dominant partner in the Windmill-street School, surgeon to the Middlesex Hospital, busily engaged on his brain theory, and just over 40 years of age. In the portrait the powder is combed from his hair and the tail is cut off, events which we know from his wife's letters took place in 1815. From the same source we know he was then "dressing himself young." In 1816 he wore a white waistcoat and green coat. There is more than a little of the dandy in Stevens's portrait. His clever elder brother John was also particular about his dress. A lock is curled flat on the forehead, the hair on the temples is brushed forwards and tinged with grey. The face is chubby, alert, and clean shaven; the mouth small, well formed, and shows determination; the nose has that character we now associate with Pitt and Chamberlain; the forehead is broad; the hands small, finely formed, and manifestly deft. The portrait conveys the impression of an alert man of action, confident of his merits and abilities; there are no signs in it of the patient student, and yet he was a laborious and painstaking student. Like many brilliant men, he had gifts and habits that kept up a constant civil war within him.

LONDON SCOTTISH SCHOOL OF ANATOMISTS.

Bell had more than a fair share of the merits and peculiarities of the London Scottish school of anatomists. All of them had tastes for the cultured side of life. James Douglas, the founder of the school, who settled in London in 1700 and died in 1742, collected editions of Horace;

William Hunter, his direct successor, not only collected rare editions, but works of art and ancient coins; John Hunter shared these tastes; Charles Bell was an artist and critic. He insisted all through his life that artists should seek their inspiration in a study of the living nude as well as in works of ancient masters. All of them became slaves of work and of ambition; a reputation as a scientist was the common aim. Such fees as came their way were used for this. They laboured to give London a world-wide reputation as a centre of medical research. Their discoveries were the only fortunes they designed for coming generations. William Hunter felt himself grievously injured when the Government prevented him from spending his fortune in building a "noble" school of anatomy for national use. John Hunter left a rich museum, a poor family, and a legacy of discovery which the medical world has not yet exhausted. Hewson—if not a Scot, yet of this school—died a martyr to research. Cruickshank died poor. So did Home, and so did Sir Charles Bell. I wonder if any system of State endowment could produce such a school. They were doubly penalised: their researches were costly in money and in time. Their incomes were apt to decrease as their scientific reputations increased. All of them formed collections and museums—expensive necessities for venture teachers of anatomy. Charles Bell had already laid the nucleus of his before he left Edinburgh in 1804; force of circumstances compelled him to part with it in 1828. It was acquired by the Royal College of Surgeons of Edinburgh, where it is still preserved and treasured. In this collection are still to be seen the dissection which James Wilson, Bell's senior partner in the Windmill-street School, made to demonstrate the muscle (compressor urethræ) still known by his name, and the dissection made by Bell to show the internal sphincter of the bladder and the muscular band in the trigone which unites the ureter to the internal sphincter (Bell's muscle). William Hunter's museum was left to the University of Glasgow, Baillie's to the Royal College of Physicians of London, Cruickshank's collection found a home in St. Petersburg, while John Hunter's, as all the world knows, was purchased by the Government and entrusted to the care of the Royal College of Surgeons of England. It forms the basis of the great collection belonging to that College.

Bell shared the virtues of the London Scottish school, and one rejoices to think he had a fair share of their very human vices. Without exception they were pugnacious men. While careless as to fortune they would fight to the death over a point of priority. The Edinburgh or Monro school shared both their virtues and their vices. Hence the angry quarrels within and between the schools. They were all men deeply in earnest; hence the jealousies, rivalries, and accusations

of plagiarisms, and the bitter quarrels which are sure signs of scientific life. They had the unconscious art of making enemies. To peaceful men who believed the medical world and its practice had reached as near perfection as could be in a fallible world they appeared arrogant and disturbers of the medical peace. Charles Bell was bred in the Edinburgh school and spent his life in the London one, and could not be expected to be peaceably inclined. Evidently he had a temper. When he attended the British Association in 1834, then in his sixtieth year, he took an opportunity in his address to remove "a very prevailing notion of the medical men in Edinburgh that I am pugnacious and sarcastic."

We know the inner life of Charles Bell more intimately than that of any other member of the London Scottish school. During the 32 years he lived in London (1804-1836) he confided freely his hopes, his cares, his aims, successes, and foibles to his elder and helpful brother George, who had attained in Edinburgh as high a reputation as a lawyer as Charles had gained in London as a surgeon and anatomist. A selection of these letters have been published; they are most valuable documents, but a harsh critic might use them to an unfair advantage. The letters leave the distinct impression that the writer had been disappointed in his life in London—that he had scarcely been rewarded according to his deserts. Yet those who knew him intimately assure us he was a happy man and enjoyed life. He was apparently one of those men, and they are not uncommon, who is happy and optimistic in speech but sour and pessimistic in writing. The man who is gruff and repelling in conversation is often the most charming letter-writer. Oliver Goldsmith was a genius only when he held his pen. Most men have dual personalities—one of speech, another in writing. Bell did complain occasionally, but Scotsmen must not be taken too literally when they grumble. Complaint is a form of mental luxury. When London had bestowed fortune and fame on William Hunter he wrote to his early guide and friend Cullen, "You have been ill-used at Edinburgh as I have been in London." The particular ill-usage which occasioned this complaint was that the Government did not encourage him to spend his fortune in building a national school of anatomy. Bell had another mental character which distinguishes the real anatomist. His memory and understanding were visual, not auditory; he learned and understood things by seeing them; words alone were poor substitute for things. As a boy Cæsar's bridges across the Rhine appealed to him and so did their construction; the rules of syntax and their able exponent, the rector of the high school, were nightmares.

BELL'S EARLY DAYS IN LONDON.

So far I have dealt merely with the more superficial and personal aspects of Bell's life and merely outlined his place in the London Scottish school. It is time now to see if the steps can be traced whereby he made for himself a permanent name in the history of anatomy and medicine. Some years ago I inquired into the circumstances which led men to follow the profession of medicine, but amongst the hundred men I then interrogated there were none who were turned to medicine by so strange a chance as the two Bells—John and Charles. Before John Bell was born, his father, a clergyman of the Episcopal Church of Scotland, had dedicated him to the medical profession, in gratitude for relief at the hands of a surgeon. John Bell was trained under Monro the second, and there was no man in Europe more able to introduce him to a useful study of the human body. In the Edinburgh, as in the London Scottish school, all research and study were bent towards discovering not the form but the *function* of parts. John Bell was a dapper little fellow, of extraordinary ability and personality; he was a splendid draughtsman, clever with his hands and head, clear and quick in speech, a born teacher, intensely practical, independent, and, above all, pugnacious. He set up a venture or extramural school in 1786 when he was 23, won success as a teacher and operator, and was soon at rivalry and war with the privileged authorities of the University. Charles, who was 11 years younger (he was born in 1774), had the same artistic gifts, and followed naturally in his footsteps. Monro was then deep in his researches in the nervous system; he had noted that only the posterior roots of spinal nerves were supplied with ganglia, and one may be quite sure he asked himself and his students the reason of such a distribution. Monro was puzzling over the meaning of the parts and arrangement of the nervous system.

The relationship between the elder and younger Bell is very similar to that between the elder and younger Hunter, John Bell was 11 years older than Charles. William Hunter was ten years older than John. The younger brothers served an apprenticeship in the dissecting-rooms of the elder. The elder brothers were busy teaching and publishing; the younger as busily researching. At the end of the apprentice years the brothers became gradually estranged. At the age of 23 (1797) Charles began his system of dissections and illustrations. By 1800 the quarrels between John Bell and the University had come to a climax. John abandoned the school to Charles; the younger brother had to bear

the brunt of the elder brother's quarrels; his way in Edinburgh was barred. Hence the prospecting visit to London in the autumn of 1804. The journey by coach took five days; he reached London on a Sunday and found it dull. The fame of his brother and of himself had gone before him. Their books, writings, and engravings had given them a place in the medical world. Charles was 30 years of age and hoped to obtain a foothold where John Hunter had laboured and become famous. Mr. Anthony Carlisle of Westminster Hospital, six years his senior, told him bluntly they liked to "manufacture their own raw material in London"; Bell's opinion was that "Carlisle has the greatest conceit of himself I ever knew a man to possess." Carlisle's colleague, Mr. Lynn, befriended the able, independent, and ambitious Scot. Was there ever a Scotsman yet who did not meet one Carlisle and many Lynns on his first venture in that strange "cock-pit" of the world—London? In those waiting days Bell rode out with Abernethy, who knew how to cover 22 miles of road at the cost of $1\frac{1}{2}d.$ for tolls; he dined with Sir Joseph Banks and Dr. Matthew Baillie, and enjoyed gentle flirtations in the agreeable society of Sir William Blizard's daughters. A year passed and nothing came to him, and hence the venture already mentioned of taking Speaker Onslow's old house in Leicester-square with £12 in his pocket and a weekly expenditure that would see his fortune dissipated in a fortnight. An onlooker would scarcely expect that Bell's course was leading towards the discovery of a new anatomy of the brain.

Then comes the opening lecture in the old house at the beginning of January, 1806; it was a wet night and 40 came to hear him, but only 12 enrolled themselves as pupils—bringing him a sum of £82. It was then as it is now: students as a rule do not pay fees to learn the new and the strange; they wish to have clearly set before them the plain and orthodox facts which are needed by them in examinations and practice. Bell was intensely disappointed; he dreamt of hundreds, and not even tens came. The manuscript of the "Anatomy of Expression" which he brought down from Scotland with him was finished in the meantime and published. He was "deeply mortified" when Mrs. Sydney Smith suggested it would be better to have someone to remove the Scotticisms. However, the book succeeded, and it deserved its success; it is the first and greatest of any work on anatomy for artists that has seen the light of day in this country.

WORK ON THE ANATOMY OF THE CENTRAL NERVOUS
SYSTEM.

A study of how the emotions are expressed in man led him towards the brain. No explanation could then be given of the division of this organ into lobes, nor was any particular functional meaning attached to the cerebellum. The cranial nerves were complicated in their distribution and course, and the spinal nerves had two roots just because they had been created so. On the theory of the brain then taught, a single nerve should have been sufficient for each part; one kind of nerve was enough for all kinds of sensations and impulses; the nerve path which served to bring a message to the brain also sufficed to take one away again. Bell was a close student of John Hunter's works; Hunter was his ideal; he must have known that Hunter had discovered the double nerve-supply of the olfactory mucous membrane, and that he explained the fact by supposing the first nerve was only for the sense of smell and the fifth for ordinary sensation. Hunter suggested that there were different kinds of nerves—those of the eye, the nose, and of the ear were for the transmission of special forms of sensation, and those like the fifth for ordinary sensation. This much at least is clear: the starting point of Bell's discovery was the recognition that the optic nerve transmitted only impressions connected with sight, the olfactory only with smell, the auditory only with hearing, the gustatory only with taste. There were therefore different kinds of nerves; all nerves were not functionally alike. Another of Hunter's observations may have influenced him. When a joint is flexed it was Hunter's opinion that the extensor or elongating muscles were as directly under the control of the nervous system as the flexor or contracting muscles. Bell went a step further; from his own sensations he was convinced that the muscles must be as freely supplied with nerves of sensation as with nerves of motion—a conception which Sherrington has elaborated and extended with unrivalled skill. In Bell's opinion our muscular actions were controlled from beginning to end on the impressions carried to the brain by the sensory nerves which supplied them. He could not conceive that one nerve could carry messages to and from the brain simultaneously; there must be two paths. The problem of the two roots came back to him: was it possible one was for sensation and one for motion? The nerves from the organs of sense, which he knew to be purely sensory, ended in the dorsal or posterior columns of the nerve axis; when he followed up the anterior roots he traced them in the anterior columns of the cord to the pyramidal tracts,

crusta, and cerebrum; the posterior roots he found went by the posterior columns to the cerebellum. Therefore the brain and the anterior or ventral parts of the nerve axis were connected with motion; the cerebellum and the dorsal parts of the cord and medulla were connected with sensation. That was the theory he set out to prove in 1807—the second year of his venture lectures in Speaker Onslow's old house.

In 1808 he had exhausted the anatomical evidence and tested the truth of his inference, drawn from anatomical evidence, by physiological experiment. The experiments were confirmatory, but in his opinion not altogether decisive. To reach the spinal roots and cord entailed a considerable injury to the parts operated on. If his theory were true, he inferred that it should also be applicable to the cranial nerves. There the nerves were more superficial, and it was possible to select examples in which the sensory and motor roots were not conjoined. He selected the seventh as a type of the anterior or motor nerve, divided it, and found the facial muscles were paralysed; he exposed the fifth (he did not then know of its motor root), divided some of its branches, and found common sensation was lost. Until these experiments were made the facial and fifth nerves were supposed to fulfil the common purpose of nerves. Up to Bell's time the only explanation offered for the double nerve-supply of the face was one supported by his old teacher Monro—that the fifth might still act if the facial nerve was accidentally injured or *vice versâ*. The discovery of the cause of facial palsy was a side issue; the importance of the experiment to Bell was that it demonstrated the truth of his theory from one end of the central nerve axis to the other. The ventral part was motor, the dorsal sensory.

Bell's second discovery—the recognition of a respiratory system of nerves—came about in the following way. About 1813, the year after he joined Wilson in the Windmill-street school, he made a dissection of that complex of nerves which may be exposed between the mandible above and the thorax below. He had to demonstrate them to his class next day. What explanation could he give that would account for the intricate manner in which the cranial and cervical nerves were arranged and distributed in this region? Many of these nerves—the ninth, tenth, and eleventh—did not arise either in the line of his sensory or motor roots, but intermediate to them. Why was that? He had to go to a case in the country, and on the way he discovered what he believed to be the explanation. The chief nerve of the group went to the lungs; it was functionally therefore a respiratory nerve. The other nerves arising in line with it—the sixth, ninth, and eleventh—must also be respiratory.

The muscles of the face were, in his opinion, mainly respiratory in function; the sterno-mastoid supplied by the eleventh could be used in inspiration. He was dominated by the idea that the origin of nerves must be determined entirely by function. The mechanism of respiration, he believed, had been added to the more primary actions of the body and the system of nerves which regulated it must have been interpolated in the motor and sensory systems. He supposed that an intermediate system must be represented in the cord to influence and control the respiratory action of the body wall muscles. The phrenic (internal respiratory nerve) and long thoracic (external respiratory nerve) he also supposed to belong to this system. Bell was particularly fond of his "respiratory" theory. It was the first attempt ever made to explain a certain series of complicated facts. He saw that nerves having an intermediate root origin must be different in nature from the nerves rising in the dorsal and ventral series. We had to wait 60 years before a more satisfactory explanation was given of the nerves which have an intermediate root origin. It came with the demonstration of the splanchnic system by Gaskell. But who can yet explain why the sensory system is dorsal, the ventral motor, and the intermediate splanchnic?

COMPARISON OF DISCOVERIES OF HARVEY AND BELL.

There is a remarkable similarity between the discoveries of Harvey and of Bell. Monro, as we have seen, was puzzling over the meaning of spinal ganglia when Bell was a student in Edinburgh at the end of the eighteenth century. Fabricius was trying to explain the meaning and use of valves in the veins when Harvey was studying in Padua at the end of the sixteenth century. They were designed, Fabricius thought, to secure an even distribution of the blood during its reflux from the thorax to the extreme parts of the body. Harvey and Bell came to London to observe, reflect, and experiment, and teach and practise for a livelihood. Harvey brooded over his "new" idea from 1616 to 1628 before publishing; Bell over his from 1807 to 1821. Harvey found the arrangement of valves could not be explained on the current teaching of the day. They allowed blood to pass only in one direction, and that was towards the thorax. The current teaching could offer no explanation of why the lungs required a special ventricle and an artery as big as that to the whole body for their special blood-supply. No explanation was offered for the existence of the tricuspid valve, nor for the semilunar and mitral valves. Harvey was the first anatomist to formulate as a

working principle for the investigator that the existence and form of every organ and part of the animal body is determined by function, and that by a study of form a key or guide may be obtained which will direct the inquirer as to the manner in which the function may be experimentally demonstrated. A rational study of anatomy guided Harvey and Bell to their discoveries.

On whatever standard one proceeds to judge, Charles Bell must be assigned a first place amongst the world's anatomists. He did for the anatomy of the nervous system what Harvey did for the circulatory system—brought order out of chaos. John Hunter was probably a greater discoverer than either, but he was an anatomist of life rather than of the human body. Harvey proved his thesis in every point; his demonstration was complete. His inclinations were under the sole guidance of his facts. Bell, as we have seen, sometimes allowed the facts to follow his inclinations. In Bell's favour we must take into consideration he was dealing with the most complex and elusive system of the body, one which can be interrogated with success only by the more delicate modern means which Bell had not at his command.

In conclusion, I cannot do better than quote to you a footnote from Sir Charles Bell's treatise on the "Nervous System of the Human Body": "In your department," Sir Humphry Davy said to him, "you can hope for nothing new. After so many men in a succession of ages have laboured on your subject, no further discovery can be expected." "This," writes Bell, "shows great ignorance of anatomy since every improvement points to something new, and the higher we go the more is the field of view extended." Once a new path is found there is no telling the various discoveries it may lead to. The path discovered by Charles Bell is one which has carried his successors into new and wide fields. Nor are the methods which Harvey and Bell employed to elucidate the human body exhausted; those who know the structure of man best know how obscure are many parts and organs of the human body, and how indifferently they can be explained on the basis of our current teaching.

